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The influence of two aspects of language structure, syntax and associativity, on the free recall of verbal messages was investigated. (Syntax refers to the rules for ordering words within sentences; associativity refers to the network of meaningful relationships which exist among words in a language.) Twenty-four children from each of grades kindergarten, 1, 2, and 3, were asked to randomly repeat as many words as they could remember from a series of stimulus messages. It was hypothesized that older children would benefit more from structural cues and have an increasing advantage over younger children as the tasks became more structured. Eight testing tapes were administered during two sessions using minimal stress and inflection. Each tape consisted of items with syntax and items without syntax. The hypothesis was confirmed: syntax helped only the third graders. There was significantly greater recall of the messages with associativity for all grade levels. The experiment was repeated adding intonation to the items with syntax. Intonation resulted in marked improvement in recall, particularly for messages with associativity. Because the capacity to process and store verbal information increases as children grow older, further research is required in this area. (MH)

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Language Structure and the Free Recall of Verbal Messages by Children [1]

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Structure in language refers to the patterned regularities among the elements of a language. The learning of the combinatorial patterns of phonemes, morphemes, and words facilitates subsequent verbal learning which preserves these patterns but inhibits learning which violates these patterns. In addition to the sequencing patterns of the meaningful sound elements of the language, suprasegmental aspects of language, such as, intonation, stress and juncture provide structural information which assists a listener in hearing the words and understanding the meaning of a presented message.

The development of the ability of the child to utilize different sources of structural information in language has been studied in several different ways. The use of morphological rules has been studied by Berko (1958); the word associations of children have been studied to obtain information about the development of conceptual and grammatical word classes, (Entwisle et al., 1964; Ervin, 1961; Brown and Berko, 1960); descriptive and theoretical accounts of the early development of generative grammatical rules have been provided. (Brown and Bellugi, 1964; Brown and Fraser, 1964; McNeill, 1966; Menyuk, 1969).

This study was originally designed to investigate the influence of two different aspects of language structure, syntax and associativity, on the free recall of verbal messages. Syntax is an aspect of language structure which refers to the rules for ordering words within sentences; associativity refers to the network of meaningful relationships which exist among words in a language. This study was extended to include an examination of the effects of intonation as an additional structural cue.

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In considering the effects of syntax and associativity, it was hypothesized that older children derivemore benefit from the structural cues in a verbal message and, therefore, have an increasing advantage over the younger children as the tasks become more structured. Developmental growth in memory span increases the number of units of verbal information a child can remember, but, in addition, the learning of the structure of a language increases the size of the units of verbal information which are remembered.

Experiment I

Stimulus materials. Four different kinds of word strings were generated as stimulus materials from all possible combinations of two different levels of syntax and two different levels of associativity: 1) with syntax - with associativity; 2) with syntax - without associativity; 3) without syntax - with associativity; 4) without syntax - without associativity. Five items of each of these four types were constructed. Each item was ten words long, made up of two five-word groups. In the items with syntax, each of the five-word groups consisted of an adjective, plural noun, transitive verb, adjective, and plural noun in that order. For sentences without syntax the order of the words in the sentences was reversed. All words selected for the items occurred at least 100 times in the Lorge-Thorndike Juvenile word count.

The items with syntax - with associativity were constructed first. These items are comprised of two complete, meaningful five-word sentences. Items with syntax - without associativity, sometimes referred to as anomalous sentences, were next constructed with word-by-word matching to the items with syntax - with associativity according to form class, frequency, and number of syllables. Word frequency matching was done within ± 50 on the Lorge-Thorndike Juvenile count. Associativity among the words was minimized by subjectively eliminating combinations of words within items which had conceptual or

contiguous associativity. Sequential pairs of words were selected so as to minimize semantic contextual constraints, while still retaining the grammatical constraints. The five items from each of the conditions with syntax follow:

A. With associativity - with syntax (meaningful items)

1. Swift deer jump high fences. Angry mothers punish bad boys.
2. Strong horses pull heavy wagons. Brave soldiers fight savage wars.
3. Good artists paint pretty pictures. Fierce lions climb tall trees.
4. Big waves hit rocky shores. Hungry bears eat sweet berries.
5. Happy kids play lively games. Sharp knives cut tender meat.

B. With syntax - without associativity (anomalous items)

1. Stiff heaps sold south rabbits. Narrow flowers murder free ships.
2. Wet reasons rush paper parents. Quiet tables run middle hills.
3. Last foxes sail silver gardens. Proud throats ruin cool parts.
4. Kind irons trap magic skies. Western tops build wrong spiders.
5. Great stamps drop steady coats. Poor rows save instant knees.

The five items with associativity - without syntax were generated by reversing the words in the with associativity - with syntax condition. The five items without associativity - without syntax were made by reversing the words in the without associativity - with syntax condition.

Subjects. Twenty-four Ss from each of grades kindergarten, one, two, and three were selected from a consolidated elementary school in central Pennsylvania. The mean age for each of the grades was 68.5, 79.9, 92.9, and 104.0 months respectively. The means and standard deviations for IQ for the four grades were 120.1 (13.4), 115.2 (14.1), 119.6 (14.8), 115.0 (16.0) respectively. A total of six Ss were dropped during the course of the experiment because of testing problems or illness, leaving N's of 21, 22, 23, and 24 for the kindergarten, first, second, and third grades respectively.

All stimulus materials were recorded. Eight different testing tapes were made up, each consisting of one of the sets of items with syntax and one set of items without syntax, in either of the two possible orders. Each item was recorded at the rate of one word per second with minimal stress and inflection.

Each S was tested twice in order that each S would receive all four types of items. The two administrations were separated by an interval of 7-14 days. Instructions were given to recall as many words as could be remembered, and that the order of the recalled words was not important. All responses by Ss were recorded for later scoring.

Analysis. The simple and interactive effects of three sources of variance were analyzed in a 4 x 2 x 2 fixed factor design (Winer, 1962, page 319). Age level was the only between-group source of variance; syntax and associativity were the two within-group sources of variance. The means and variances for each cell in the 4 x 2 x 2 data matrix are presented in Table 1. The dependent variable was the mean number of words recalled from each item within each level.

Insert Table 1 about here

The age main effect was highly significant ($p < .01$, $F = 31.2$) with the largest increase between grades one and two. There was a regular increase over grade level in number of words recalled in all conditions, except for the third grade. The third graders recalled approximately as many words as the second graders in three of the four conditions. It was only in the complete, meaningful sentences that the third graders showed a significant increase over the second graders.

The main effect of syntax was not significant ($F = 1.47$), but the main effect of associativity was significant ($p < .01$, $F = 18.0$). Both the inter-

action between grade level and syntax ($p < .01$, $F = 5.00$) and the interaction between grade level and associativity ($p < .01$, $F = 6.04$) were significant. Analysis of simple effects indicates that there were no significant differences between conditions with and without syntax except for the third graders who recalled significantly more from the sentences with syntax than from the sentences without syntax ($F = 10.1$, $p < .01$). Analysis of simple effects with respect to associativity indicates significantly greater recall of the messages with associativity for all grade levels. The interaction between age and associativity results from a steady increase over grade level in the difference between the recall of high and low associativity messages.

Discussion. Both of the interactions of associativity and syntax with grade-level resulted from older children obtaining more benefit than younger children from the structured conditions. The interaction between age levels and syntax levels resulted from differential performance across grade levels. Only the third graders remembered more from the sentences with syntax than the sentences without syntax. The items with associativity were recalled better than the items without associativity by all grade levels, but the difference between the two conditions increased regularly over the four grade levels.

The most surprising finding was the lack of an effect due to syntax for all groups. With the exception of the third graders, children remembered as many words from such items as, "swift deer jump high fences - angry mothers punish bad boys," as they remembered from these items in reverse order. The Ss' recall performance indicated that they were not aware that these were complete sentences. That is, they did not recall whole phrases from the meaningful items, but rather recalled individual words, with the last words presented being remembered best.

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In seeking an explanation for the finding of no syntax effect, it is well to remember that the items were presented to the Ss with no intonation at the rate of one word per second. Without the usual intonation and other suprasegmental features, the meaningfulness of the sentences was apparently not recognized. A second experiment was designed to study the effects of adding an intonational pattern to some of the stimulus sentences.

Experiment II

Stimulus materials. Additional stimulus materials were constructed by adding intonation to all of the items with syntax. The rate of presentation and word junctures were kept the same as in the first experiment. Each of the five-word sentences which comprise the items had the same basic syntactic pattern and were presented with the intonation pattern indicated by the varying level of the words in, Swift deer jump high fences.

Additional recall data on these intonated sets of stimulus sentences were collected from the Ss described previously. A period of approximately four months elapsed between the testing for Experiment I and Experiment II. Not all of the Ss were available for retesting under the intonation condition. Of the originally tested in each grade, 18, 19, 19, and 13 were available from each of the kindergarten, first, second, and third grades respectively.

Analysis. The means and standard deviation for the recall of the four grade levels under the intonated and non-intonated conditions are presented in Table 2. The means and standard deviations for the non-intonated condition are based on data from Experiment I. These values remained virtually unchanged as a result of the deletion of the Ss who were not retested.

Insert Table 2 about here

An analysis of the effects of intonation was done by comparing performance on the two types of sentences with syntax under intonated and non-intonated conditions for the subjects at four grade levels. This analysis was a 4 x 2 x 2, fixed factor analysis, with grade-level as the between subjects factor and associativity and intonation as two within-subject factors. As was expected from the previous analysis, grade-level and associativity were again highly significant ($p < .01$, $F = 20.2$, $F = 107.6$ respectively). Intonation also proved to be a highly significant main effect ($p < .01$, $F = 58.7$). The associativity x intonation interaction was significant ($p < .01$, $F = 9.2$). This interaction resulted from the differential effect of intonation on the recall of messages with and without associativity. Adding intonation to the messages without associativity resulted in small increases in recallability; adding intonation to the messages with associativity produced large increases in recallability. The grade level x intonation interaction was not significant ($F = 1.5$).

Discussion. Six scores were available for those 70 Ss who participated in both experiments. The mean scores for each of the conditions and each of the grade levels is summarized in Figures 1 and 2. Figure 1 illustrates mean recall scores for items without associativity when presented (1) without-syntax-without intonation, (2) with syntax-without intonation, and (3) with syntax-with intonation. Figure 2 illustrates mean recall scores for items with associativity under the same three presentation conditions.

Insert Figures 1 and 2 about here

Comparing conditions (1) and (2) within each of the Figures indicates that the effect of putting the words in grammatical order did not significantly affect the recall of either type of item for all grade levels, with the one

exception of the third graders in the associative condition. The effects of intonation - comparing condition (2) with condition (3) - are clearly present for both types of items at all grade levels.

The reader should be cautioned regarding the circumstances which influence the interpretation of the results obtained under the intonation condition. A four month period of time elapsed between the administration of the non-intonated and intonated items. Thus, both developmental and order effects could account for some of the intonation effect. However, the size of both of these effects can be estimated from the data in Experiment I. The effect that could be attributed to four months growth is relatively small in comparison to the difference between the intonated and non-intonated condition. The analysis of order effects within Experiment I indicated that no increase would be predicted on a third testing session as a result of practice or order-effects. The order effect was significant when comparing the first and second set of items within the first session but no order effects were significant for additional comparisons. Thus, despite the confounding effects, the influence of intonation on recall seems to be a strong one.

Very little systematic empirical research has been done to study the effects of intonation on the recallability or comprehensibility of verbal messages. Some anecdotal accounts with young children have attested to the importance of intonation in determining the meaning of a verbal message (Schafer, 1922; Lewis, 1936, reported in Lieberman, 1967). Linguist have discussed intonation with respect to the kind of information which it provides (Bolinger, 1958; Danes, 1960). They maintain that intonation undoubtedly provides information about the grammatical structure and meaningfulness of a sentence, but that the relationship between the intonation pattern of a sentence and its grammatical structure is governed by complex rules which are

as yet not systematically known. Practically no empirical evidence is available concerning the role of intonation in the interpretation of language by elementary school age children.

The elementary grade children in the present research did not make use of the grammatical structure of a verbal message unless appropriate intonational cues were provided. Even with the intonation, some children indicated by their recall pattern that they did not recognize the stimulus sentences as complete, meaningful sentences. Some responded with single, isolated words in no grammatical order, rather than with sentences or grammatical phrases, while others responded with phrases and complete sentences. Apparently children in the early elementary grades require the presence of suprasegmental features, such as stress, pitch, and juncture in order for them to interpret a message as meaningful natural language. A number of adults have been tested on the stimulus materials from this study. All of the adults tested on the meaningful sentences without intonation remembered them as complete sentences, and remembered almost all of the words. The performance of the adults is thus markedly different than the third graders indicating that addtional development in the utilization of sentence structure occurs after that age.

It is generally agreed that a person's grammatical competence is fully acquired by the time he is ten years old, the age of the third grade subjects in this research. The capacity to process and store verbal information, however, continues to increase beyond this age. The redundancies resulting from the interplay of syntax, associativity, and suprasegmental features are learned and permit the adult to understand a verbal message when much of the message is removed. The dynamics of this growth process are largely unexplored and require extensive research.

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FOOTNOTE

[1] A paper with this title based on the research reported here was presented at the 1969 annual meeting of The American Educational Research Association in Los Angeles on February 6, 1969.

Table 1

Means and Standard Deviations for Number of Words Recalled for Four Grade Groups From Items With or Without Syntax and Associativity

Grade*		Presentation Conditions			
		W/o Syntax		With Syntax	
		W/o Assoc.	With Assoc.	W/o Assoc.	With Assoc.
Kindergarten	$\bar{x}$	1.86	2.34	1.88	2.43
	s	.72	.81	.48	.76
First	$\bar{x}$	2.31	3.01	2.36	2.87
	s	.65	.80	.68	.59
Second	$\bar{x}$	3.13	3.94	3.07	3.73
	s	.74	.73	.63	.76
Third	$\bar{x}$	3.00	3.92	3.13	4.51
	s	.52	.70	.84	.94

* N's for grades are 21, 22, 23, and 24 respectively.

Table 2

Means and Standard Deviations for Number of Words Recalled for Four Grade Groups for Items With or Without Intonation and Associativity

Grade*		Presentation Conditions			
		W/o Intonation		With Intonation	
		W/o Assoc.	With Assoc.	W/o Assoc.	With Assoc.
Kindergarten	$\bar{x}$	1.82	2.33	2.57	3.60
	s	.46	.72	.52	1.22
First	$\bar{x}$	2.34	2.92	2.67	3.45
	s	.71	.52	.70	.85
Second	$\bar{x}$	3.13	3.76	3.47	5.26
	s	.66	.78	.81	1.89
Third	$\bar{x}$	3.26	4.53	3.86	5.43
	s	.88	1.03	.64	1.56

* N's for grades are 18, 19, 19, and 13 respectively.

FIGURE CAPTIONS

Figure 1 - Recall of Messages Without Associativity Under Three Condtions by Four Age Groups

Figure 2 - Recall of Messages With Associativity Under Three Conditions by Four Age Groups

Figure 1

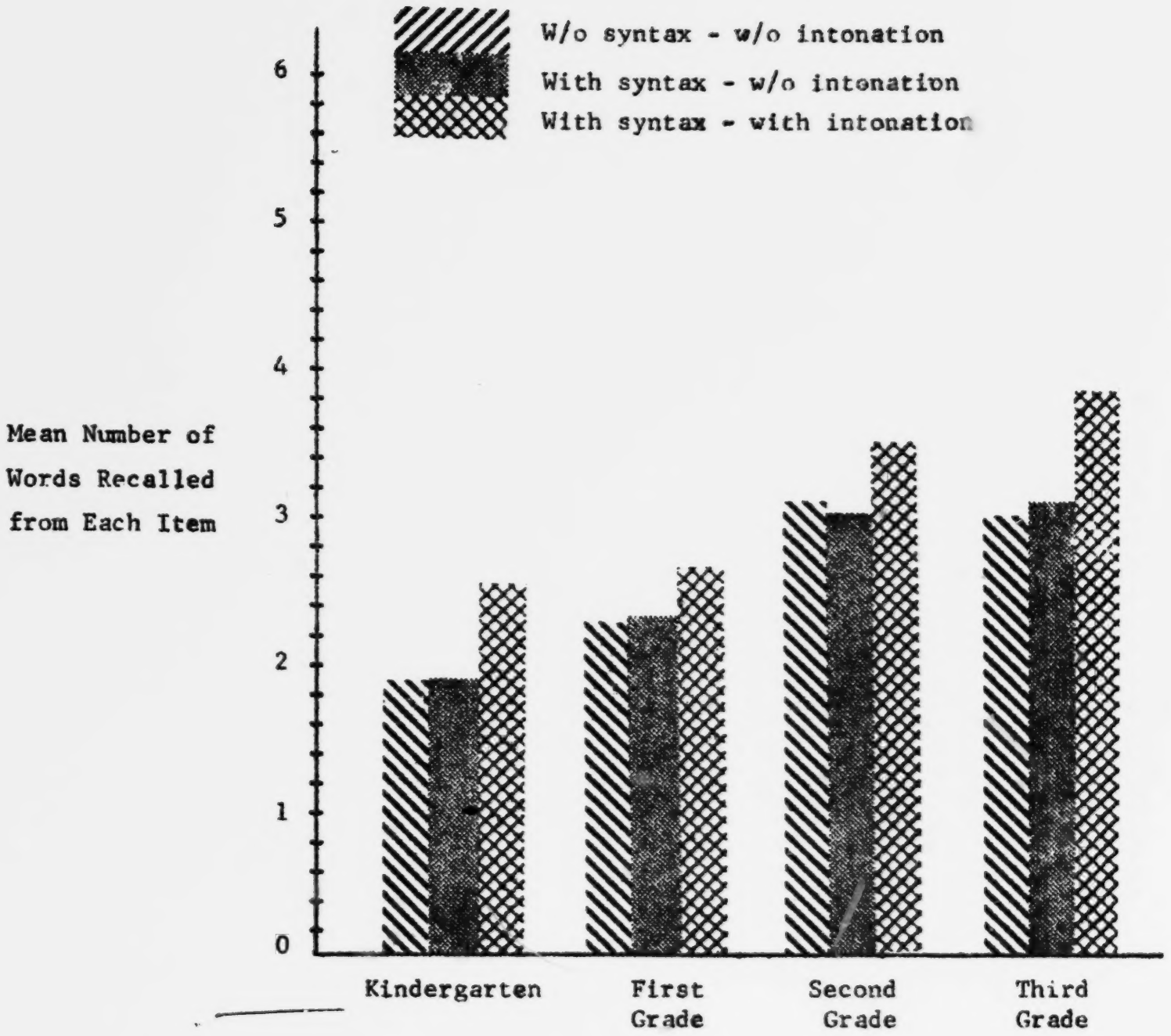
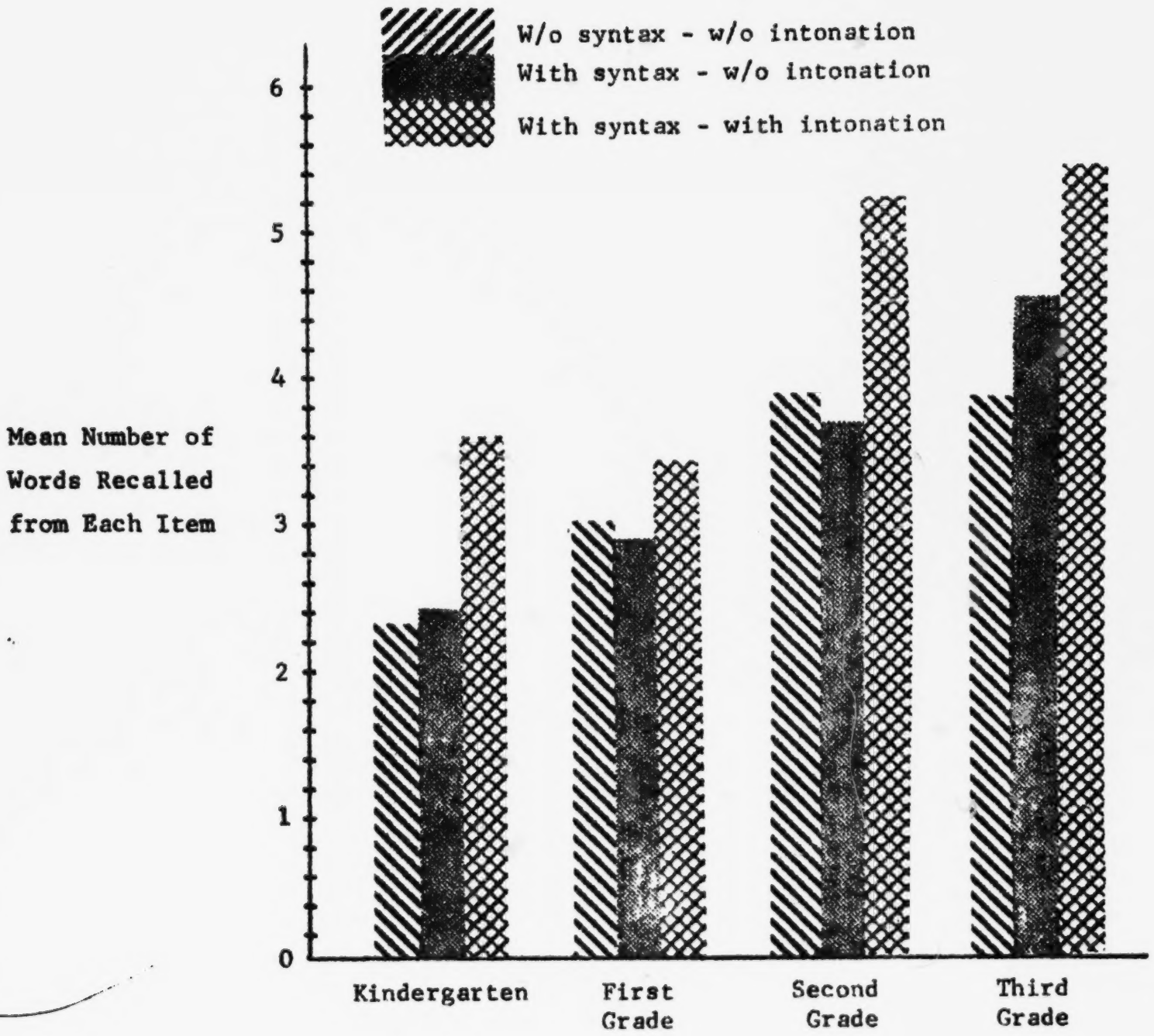

W/o syntax - w/o intonation
With syntax - w/o intonation
With syntax - with intonation
Mean Number of Words Recalled from Each Item
6
5
4
3
2
1
0
Kindergarten
First Grade
Second Grade
Third Grade

Figure 2


W/o syntax - w/o intonation
With syntax - w/o intonation
With syntax - with intonation
Mean Number of Words Recalled from Each Item
0
1
2
3
4
5
6
Kindergarten
First Grade
Second Grade
Third Grade